Serial No.: 09/601,886

IN THE TITLE:

Page 1, please replace the existing Title with the following:

a1 CODE DIVISION MULTIPLE ACCESS COMMUNICATION SYSTEM.

IN THE SPECIFICATION:

Please replace the paragraph at page 1, line 4 with the following new paragraph:

A2

This invention relates to Spread Spectrum Communication System, particular to Code Division Multiple Access Communication System which is capable of performing a high speed synchronization.

Please replace the paragraph at page 3, line 25 with the following new paragraph:

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To solve the above problems, the present inventors suggest the following code division multiple access communication system. First, in a transmitter, a code division multiple signal which is composed of a data division obtained by multiplying an orthogonal code by a baseband and a preamble division to synchronize the orthogonal code in a receiver is transmitted. Second, in the receiver, the correlation peak is detected from the synchronized code sequence in the preamble division by an surface acoustic wave matched filter. At last, the orthogonal code is generated based on the detection timing, and the received baseband data in the data

division is demodulated by the orthogonal code. Such a code division multiple access communication system is described in for example, Kokai Publication 9-261121(JP A 09-261121). Hereinafter, the surface acoustic wave matched filter is called as a "SAW MF". The "SAW MF" is abbreviated from the wording "Surface Acoustic Wave Matched Filter".

Please replace the paragraph at page 4, line 11 with the following new paragraph:

The above-mentioned code division multiple access communication system can synchronize the orthogonal code at a high speed. Moreover, the surface acoustic wave matched filter is a passive device, and has small electric power consumption, so that it can essentially provide a receiving station having a small stand-by electric power. Furthermore, since the surface acoustic wave matched filter can correlate the code sequence of surface acoustic wave matched filter with a code division multiple signal including a carrier, it can correlate in a GHz band or RF band if it can made of a suitable material for such bands. Therefore, since a received signal in a RF band is directly input and

Q4 correlated in the surface acoustic wave matched filter, a pretreatment such as a down converting is not advantageously required. As described later, a SAW MF having an "aluminum nitride/sapphire" structure including an aluminum nitride film is suitable for the SAW MF which can operate in the GHz band.

Please replace the paragraph at page 4, line 25 with the following new paragraph:

In the conventional code division multiple access communication system described in the above Kokai Publication 9-261121(JP A 09-261121), the preamble division is composed of a packet division for synchronization having a Barker code of 11 chips as a code sequence for synchronization and a dummy division of 5 chips next to packet division for the synchronization, and the data division is composed of n-sequential symbols of 1024 chips demodulated by the orthogonal code. As mentioned above, in the conventional code division multiple access communication system, there is the preamble division in the receiver in order to generate the synchronized orthogonal code with the chips in the data division of the received code division multiple signal. However,

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the code division multiple signal has only one code sequence for synchronization at the front of one packet, so that the packet can not be received entirely if the code sequence for synchronization is not detected. Since there are large influences resulted from various noises, multipass and cross talk between the adjacent cells in wireless communication, the correlation peak of the code sequence for synchronization can not be detected in good condition if the preamble division has only one code sequence for synchronization.

Please replace the paragraph at page 5, line 15 with the following new paragraph:

Moreover, in the conventional code division multiple access communication system, the receiver generates the carrier which is synchronized with the carrier of the code division multiple access signal made from correlation peaks, i.e. output signal from the surface acoustic wave matched filter, and combines the generated carrier with the orthogonal code generated as mentioned above, and demodulates the baseband data by multiplying the combined signal by the received signal. The synchronized carrier with received

carrier in phase and frequency can be reproduced, in the period when the correlation peak of the surface acoustic wave matched filter appears,. However, the communication circuit is required to be devised to reproduce the carriers in the short period when the correlation peak appears. Therefore, the circuit structure using a simple method is desired.

Please replace the paragraph at page 5, line 27 with the following new paragraph:

It is a first object of the present invention to provide a code division multiple access communication system which can attain the chip synchronization in the code sequence for synchronization precisely at a high speed even under a bad communication environment, and thus, can remove the disadvantage of being incapable of receiving the packet entirely.

Please replace the paragraph at page 6, line 4 with the following new paragraph:

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It is a second object of the present invention to provide a code division multiple access communication system which can demodulate the baseband data precisely from the correlation peak of the surface acoustic wave matched filter without the carrier synchronized to the received signal, in addition to realizing the first object.

Please replace the paragraph at page 6, line 10 with the following new paragraph:

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This invention relates to a code division multiple access communication system in which in a transmitter, a code division multiple access signal, composed of a data division obtained by multiplying a baseband data and an orthogonal code and a preamble division including synchronization code sequences to attain the chip synchronization of the orthogonal code in a receiver, is modulated with a carrier having a given center frequency and transmitted, and in the receiver, a correlation peak is detected

a9 from among the synchronization code sequences in the preamble division by a surface acoustic wave matched filter and the baseband data in the data division is demodulated by the orthogonal code generated on the detection timing, wherein the preamble division has plural synchronization code sequences, and the surface acoustic wave matched filter detects the correlation peak of at least one from among the plural synchronization code sequences and generates the orthogonal code on the detection timing of the correlation peak.

Please replace the paragraph at page 6, line 25 with the following new paragraph:

a10 According to the code division multiple access communication system of the present invention, the orthogonal code with the chip synchronization can be generated if at least one of the plural synchronization code sequence in the preamble division of the transmitted signal can be detected by the surface acoustic wave matched filter, which prevents the dropout of the whole packet.

Please replace the paragraph at page 7, line 19 with the following new paragraph:

In this invention, for ironing out this problem, it is preferable that in a code division multiple access communication system in which in a transmitter, a code division multiple access signal, composed of a data division obtained by multiplying a baseband data and an orthogonal code and a preamble division including synchronization code sequences to attain the chip synchronization of the orthogonal code in a receiver, is modulated with a carrier having a given center frequency and transmitted, and in the receiver, a correlation peak is detected from among the synchronization code sequences in the preamble division by a surface acoustic wave matched filter and the baseband data in the data division is demodulated by the orthogonal code generated on the detection timing, the period of the synchronization burst in the preamble division (T_{burst}), which is composed of a synchronization packet division having at least one synchronization code sequence and a dummy division next to the packet division, is set equally to the integral multiples of the period of one symbol in the data division (T_{symbol}). In particular, it is most preferable that T_{burst} is equal to T_{symbol} in the data division.

Please replace the paragraph at page 8, line 7 with the following new paragraph:

According to the preferred code division multiple access communication system, in the case that the preamble division has 10 synchronization code sequences having the same structure, for example, if at least one correlation peak from among the synchronization code sequences is detected, the orthogonal code can be generated, in accordance with the start timing of the first symbol in the data division.

Please replace the paragraph at page 8, line 20 with the following new paragraph:

Moreover, the present invention to realize the second object as mentioned above relates to a code division multiple access communication system in which in a transmitter, a code division multiple access signal, composed of a data division obtained by multiplying a baseband data and an orthogonal code and a preamble division including synchronization code sequences to attain the chip synchronization of the orthogonal code in a receiver, is

modulated with a carrier having a given center frequency and transmitted, and in the receiver, a correlation peak is detected from among the synchronization code sequences in the preamble division by a surface acoustic wave matched filter and the baseband data in the data division is demodulated by the orthogonal code generated on the detection timing, wherein in the receiver, the orthogonal code which is generated on the detection timing of the correlation peak in the surface acoustic wave matched filter is multiplied by the received code division multiple signal to generate a narrow-band modulation signal, and the generated narrow-band modulation signal is demodulated by a carrier generated from a local oscillator provided in the receiver to reproduce the original baseband data.

Please replace the paragraph at page 9, line 10 with the following new paragraph:

In a preferred embodiment of the code division multiple access communication system according to the present invention, the carrier having the frequency equal to the center frequency of the carrier generated in the transmitter is generated, and is

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multiplied by the narrow-band modulation signal to demodulate the baseband data.

Please replace the paragraph at page 9, line 25 with the following new paragraph:

a15

Furthermore, in the present invention, it is ascertained that when the repeated number N_{burst} in the plural bursts constituting the preamble division is set to 5-15, particularly 6-12, the probability of the dropout of the whole packet due to not attaining the chip synchronization is much less than that of the conventional code division multiple communication access system.

Please replace the paragraphs beginning at page 10, line 17 through page 11, line 9 with the following new paragraphs:

a16

Fig. 1 is a diagrammatic view showing entirely the construction of the code division multiple access communication system of the present invention,

Fig. 2 is a diagrammatic view showing an embodiment of the construction of a code division multiple access communication system in the code division multiple communication system of the present invention,

Fig. 3 is a block diagram showing the construction of a base station in the code division multiple access communication system of the present invention,

Fig. 4 is a diagrammatic view showing a transmission signal from the base station,

Fig. 5 is a block diagram showing the construction of a mobile station in the code division multiple access communication system of the present invention,

Figs. 6A and 6B are diagrammatic views showing a spectrum spread signal and a narrow-band modulated signal, respectively,

Fig. 7 is a block diagram showing the construction of another mobile station in the code division multiple access communication system of the present invention,

Fig. 8 is a block diagram showing the construction of still another mobile station in the code division multiple access communication system of the present invention, and

Please replace the paragraph at page 12, line 19 with the following new paragraph:

Fig. 1 diagrammatically shows the construction of the cell-network using the code division multiple access communication system of the present invention. Base stations 2a and 2b are provided in for example, local area cells 1a and 1b having a radius of about 150 m, and are connected to a control station 3 via for example, optical fibers. Plural mobile stations 4a, 4b ··· can move in the local cells 1a and 1b freely, and the base stations 2a and 2b detect constantly which mobile station moves to the local area cell to which the base stations belongs. Each of mobile stations 4a, 4b ··· communicates with the base stations 2a and 2b. The communication for the base station from the mobile station is called as a "up link", and the communication for the mobile station from the base station is called as a "down link". In the down link, the base station transmits signals to the mobile station in the same cell at the same timing, and the mobile station selectively demodulates the signals for itself from among the transmitted signals. As mentioned above, this invention relates to the down link technique. For enhancing the usability of the cell-network, it is important to set as many channels as possible in one cell.

In this invention, for realizing this object, the baseband data are demodulated by the orthogonal code having a chip length N.

Please replace the paragraph at page 13, line 21 with the following new paragraph:

Fig. 2 is a diagrammatic view showing the construction of a code division multiple access signal packet in the code division multiple access communication system of the present invention. The Q18 code division multiple signal packet has a preamble division including plural synchronization code sequences to perform the chip synchronization and a data division including the baseband data demodulated by an orthogonal code. The preamble division has plural repeated synchronization burst which has synchronization packet division including the synchronization code sequences and dummy division next to the synchronization packet division.

Please replace the paragraph at page 16, line 1 with the following new paragraph:

As described later, in the case of transmitting the code division multiple access signal packet shown in Fig. 2 practically, the packet is multiplied by the carrier having a center frequency of f_0. The carrier center frequency f_0 is set to 2.484MHz in consideration of the rule of Radio Law, and the band width is set to the range of 26MHz-width. In this case, the rule of RCR STD-33 is considered. In view of the rule, the chip rate of the code division multiple access signal packet (R_{chip}) is determined. In this embodiment, the chip rate of the synchronization code sequence in the preamble division (R_{pre}) is set to 22cps, and the chip rate of the orthogonal code in the data division (R_{data}) is set to 11Mcps, which is half as large as the chip rate R_{chip}. As mentioned above, since the chip length is set to 64 chips, the data rate D of the data division is set to about 171kbps from the equation $R_{data}/N=D$. As is apparent from the equation, as the chip length N is increased, the chip rate R_{data} is decreased, and as the chip length N is decreased, the chip rate R_{data} is increased.

Please replace the paragraph at page 17, line 23 with the following new paragraph:

Fig. 3 is a block diagram showing the construction of base stations (transmitting stations) 2a and 2b, which is similar to a conventional one. That is, a baseband data to be transmitted from the baseband data-generating circuit 11 is supplied to a first multiplier 12, and then, the Barker code sequence of 11 chips and the orthogonal m-sequential code of 64 chips which are output from a spread signal-generating circuit 13 at a given timing are supplied to the multiplier 12, to generate the code division multiple access signal packet shown in Fig. 2. The thus generated code division multiple access signal packet is supplied to a second multiplier 14 and is multiplied by the carrier output from a carrier-generator 15, and then, the thus obtained output is transmitted via an antenna 16. The carrier has the center frequency f_0 of 2.484MHz, as mentioned above. In the embodiment shown in Fig. 2, the baseband data is multiplied by the spread code and the carrier in turn, but the multiplying turn may be reversed. That is, the baseband data may be multiplied by the carrier and the spread code in turn. Mathematically, the multiplication give the same result irrespective of the multiplying turn. However,

since many circuits to treat 2.4GHz band-signals are required in a transmitter if the baseband data is multiplied by the carrier firstly, it is difficult to shield high frequency signals disadvantageously.

Please replace the paragraph at page 18, line 15 with the following new paragraph:

Fig. 4 shows diagrammatically a code division multiple communication signal from the base stations 2a or 2b. As mentioned above, the preamble division has 10-repeated synchronization bursts, each being composed of the synchronization packet division and the data division. Since in the data division, the baseband data is modulated in spread spectrum by the orthogonal m-sequential code of 64 chips, one data packet includes code division multiple access signals of 500 symbols corresponding to 63 channels of channel 1 to channel 63. Fig. 4 shows diagrammatically that the preamble divisions are transmitted to the 63 channels in common. As mentioned above, the period of the synchronization burst in the preamble division (T_{burst}) is the same as the period of the symbol in the data division (T_{symbol}).

Please replace the paragraph at page 18, line 27 with the following new paragraph:

Fig. 5 shows a construction of mobile stations (receiving stations) 4a, 4b··· In the conventional code division multiple access communication system in the above Kokai Publication 9-261121(JP A 09-261121), the mobile station detected the carrier included in the correlation peak from the surface acoustic wave-matched filter (SAW MF) and generated the carrier synchronized with the carrier of the received signal. Then, the combined signal of the generated carrier and the synchronization code sequence was multiplied by the received signal to reproduce the original baseband data. Since the correlation peak from the surface acoustic wave matched filter (SAW MF) has a short period of 500nsec, it is actually very difficult to reproduce the carrier from the received signal precisely in the short period. This invention does not require to reproduce the carrier from the received signal.

A 22

Please replace the paragraph at page 19, line 12 with the following new paragraph:

The mobile station branches the code division multiple signal received at an antenna 21 by a branching filter 22, and one of the branched signals is supplied to a gain-variable amplifier 23. A level detector 24 detects, when the signal branched by the branching filter 22 is received, the electric power level of the received signal. A controlling signal generator 25 generates, when the output signal of the level detector 24 is received, a controlling signal, which is supplied to the amplifier 23 as a gain controlling signal. These circuits constitutes an automatic gain controlling circuit, and the amplifier 23 output a signal of a given level constantly. In Fig. 5, the received signal is directly input into the level detector, but the signal from the rear end of the SAW MF, that is, from between the SAW MF 26 and the enveloped cymoscope 27 is directly input into the level detector. Herein, the level detector 24, the controlling signal generator 25 and the gain-variable amplifier 23 may not be provided, depending on the use of the code division multiple access communication system. However, it may trouble the signal treatment after the enveloped cymoscope 27.

A23

Please replace the paragraph at page 24, line 9 with the following new paragraph:

Fig. 8 is a block diagram showing a still another mobile station usable for the code division multiple access communication system of the present invention. In this embodiment, the same reference is given to the same part. As mentioned in Kokai Publication 9-261121(JP A 09-261121), the carrier included in the correlation peak from the surface acoustic matched filter 26 is detected and reproduced, and the combined signal of the reproduced carrier and the orthogonal code is multiplied by the spectrum spread signal to demodulate the original baseband data.

Please replace the paragraph at page 25, line 8 with the following new paragraph:

The thus generated carrier is combined with the orthogonal code with the chip synchronization generated in the orthogonal code-generator 29 at a first multiplier 52. The combined signal is multiplied by the code division multiple access signal received at

C125

a second multiplier 53, and the output signal is supplied to a integrator 54 to demodulate the original baseband data.

Please replace the paragraph at page 27, line 19 with the following new paragraph:

As mentioned above, according to the code division multiple access communication system of the present invention in which the preamble division has the plural synchronization code sequences, the chip synchronization can be attained by detecting the correlation peak of one from among the plural synchronization code sequences. Therefore, the chip synchronization can be attained precisely at a high speed under a bad environment, and the dropout of the whole packet can be prevented extensively.

C26

Please replace the paragraph at page 27, line 27 with the following new paragraph:

C27 Furthermore, according to the code division multiple access communication system of the present invention in which the period

of the synchronization burst including the synchronization code sequence in the preamble division is set to be integral times as long as , particularly equal to, the period of the symbol in the data division, since the orthogonal code can be generated in accordance with the start timing of the symbol in the data division by detecting the correlation peak of one from among the plural synchronization code sequences in the preamble division, the chip synchronization can be attained precisely.

Please replace the paragraph at page 28, line 8 with the following new paragraph:

Moreover, according to the code division multiple access communication system of the present invention in which the baseband data is demodulated on the carrier generated in the mobile station independently, since it is not required that the carrier is generated from the received signal at the antenna, the baseband data can be demodulated precisely.